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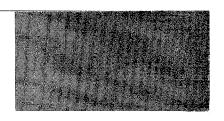## No. 405

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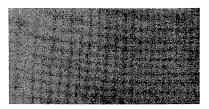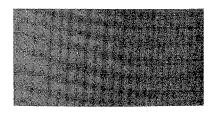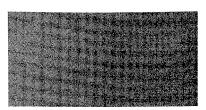
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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

GEOPHYSICS, ASTRONOMY AND SPACE

No. 405

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CONTENTS   PAGE

d

I. ASTRONOMY

News

SOLAR ACTIVITY RECORDED ON FILM BY USSURIYSK SCIENTISTS

Moscow IZVESTIYA in Russian 3 Aug 77 p 4

[TASS Report: "The Sun Through the Lens"]

[Text] Ussuriysk. Astronomers at the Ussuriysk Station of the Sun Service have made a film about the origin and development of sunspots. The possibility of preserving on film the details of solar activity was discovered by scientists thanks to a new chromospheric telescope with a calcium filter which has been put into operation. [5]

NOTES ON ASTEROID STUDIES

Moscow IZVESTIYA in Russian 30 Jul 77 p 6

[Article by F. Priymachik, "Service of the Minor Planets"]

[Summary] Recently at a plenary session of the Astronomical Council USSR Academy of Sciences at Kiev five Soviet researchers were awarded medals for the discovery of new astronomical objects. These included the Crimean astronomers N. Chernykh, L. Chernykh and T. Smirnova, specialists in the field of observations of asteroids and comets. The leading center for the study of the minor planets in the USSR is the Institute of Theoretical Astronomy in Leningrad. In its annual publication "Ephemerides of the Minor Planets" it publishes tables of the motion of all already known asteroids, whose number is now approaching 2,000. Refinement of their orbits requires that they be constantly watched. The year 1964 marked the beginning of regular investigations of the minor planets at the Crimean Astrophysical Observatory under the direction of Candidate of Physical and Mathematical Sciences Nikolay Chernykh. In a short time the Crimean group entered the ranks of the leading observatories in this field. Up to one-third of all the observations of the minor planets with assigned numbers are observed by this small group. And such observations are made by 50 observatories

1

in 30 countries! There is a long list of unnumbered asteroids discovered in the Crimea (there are more than 4,000). Much valuable material has been accumulated concerning them and 40 of these minor planets have been assigned names or numbers and have been incorporated in the catalogue. This is approximately a third of the total number of world discoveries in this field during the last ten years. The internationally approved list of newly discovered asteroids includes bodies given the names Severnyy (in honor of the director of the Crimean Astrophysical Observatory, Academician A. Severnyy), Mikhaylov, Kulikov, Makover, Chebotarev, Shaposhnikov, Masevich and Ambartsumyan (Soviet astronomers). In honor of space pioneers a group of minor planets has been assigned the names Gagarin, Dobrovol'skiy, Volkov, Patsayev, Komarov and Korolev.
[206]

Abstracts of Scientific Articles

DIFFUSE REFLECTION WITH REDISTRIBUTION OF EMISSIONS

[Article by A. G. Nikogosyan, Byurakan Astrophysical Observatory, Armenian Academy of Sciences, "Problem of Diffuse Reflection with Redistribution of Emissions by Frequencies and Directions"]

[Abstract] The diffusion of emissions in a spectral line is accompanied by a redistribution of radiant energy by frequencies. Although a number of studies have been published concerning the formation of spectral lines with a true redistribution law, due to the complexity of the problem the authors limited themselves to an examination of a redistribution law averaged by directions. For this case it was possible to develop easier solution methods based on representation of the redistribution function in the form of a bilinear expansion in some system of orthonormalized functions. Insofar as the author knows, the problem of the influence of the dependence of the redistribution law on the scattering angle in the final result has not yet been considered. Here an effort is made to apply known effective solution methods to this more general case. N. B. Yengibaryan and the author (DOKL. AN ArmSSR, Vol 54, 91, 1972) took a step in this direction by examining the problem of diffuse reflection of light from a semi-infinite homogeneous medium with allowance for incoherence and nonisotropicity of an elementary scattering event. The Ambartsumyan invariance principle was applied. In this new article various difficulties are overcome and relatively simple equations have been derived. Also a method proposed by the author and G. A. Arutyunyan (DAN, Vol 229, 583, 1976) has been broadened and clarified. [218]

II. METEOROLOGY

News

NOTES ON METEOROLOGICAL EXPERIMENTS

Moscow OGONYEK in Russian No 28, July 77 pp 22-24

[Article by S. Vlasov, "Adjusting the Weather"]

[Summary] An IL-18 aircraft of the Central Aerological Observatory, together with a similar aircraft of the Main Geophysical Observatory, participated in the POLEKS-Sever (Polex-North) experiment. The main purpose of the Polar Experiment, organized by the scientists of the Arctic and Antarctic Scientific Research Institute, under the direction of A. F. Treshnikov, was a quantitative evaluation of those factors which largely govern the state of the atmosphere... Recent investigations of the Atlantic by Soviet scientists made it possible to detect enormous eddy movements of ocean water. This completely changes our fundamental ideas concerning the ocean. It was found that most of its energy is not in permanent currents, as envisioned before, but in gigantic vortices similar to atmospheric cyclones. Scientists were also surprised to find that the ocean is stratified into thin layers, with a thickness from ten to one meter, with different temperature and salinity and different directions of movement. The next expedition is "Musson-77." It began recently in the Indian Ocean; its purpose is to find reliable methods for long-range weather forecasting. Such field experiments are parts of the grandiose GARP program, in which countless countries are participating. For a three-day forecast it is necessary to study the atmosphere of the entire northern hemisphere. The basic experiments of GARP are planned for 1978-1980. It will involve use of a whole system of automatic buoys and tens and hundreds of scientific ships. An enormous role will be played by the information arriving from aircraft and satellites.
[202]

NEW "KRAMS" AUTOMATIC METEOROLOGICAL STATION IN RIGA

Moscow IZVESTIYA in Russian 2 Aug 77 p 5

[TASS Report, "Automatic Machines Make Predictions"]

[Text] Riga. Wind speed, low cloud boundaries, horizontal visibility, moisture content of the air, atmospheric pressure -- here is a far from complete list of weather parameters which are successfully being covered by a complex radioengineering automatic meteorological station called "KRAMS." The station was developed and built at an experimental hydrometeorological instrument plant in collaboration with the Main Geophysical Observatory imeni Voyeykov. Information is transmitted to airport dispatcher services. [5]

Abstracts of Scientific Articles

ORDERED MINIMIZING OF RISK FOR METEOROLOGICAL PREDICTION

[Article by L. N. Romanov, S. V. Lebedev and G. S. Stepanenko, Computation Center, Siberian Department USSR Academy of Sciences, "Method for Ordered Minimizing of Risk for Predicting the Diurnal Variation of Meteorological Elements"]

[Abstract] A so-called piecewise-constant regression model is used in formulating a method for the ordered minimizing of risk for predicting the diurnal variation of meteorological elements. The method is described in detail, with derivation of the required formulas. The model was used for the prediction of the diurnal variation of temperature at Novosibirsk. The description of the situation involved 255 components constituting data from meteorological observations made at 19 radiosonde stations and ground observations made around Novosibirsk. The processing of the prognostic information was based on 1,488 June-August situations. For example, a program for routine calculation of the diurnal variation of temperature was written in "Vesna" computer codes. The time required for this program was four minutes and half of this time is expended on the readout of archival data from a tape. In the course of readout there is selection of 16 situations closest to the current situation in the metrics of initial space. The readout of information from the tape and the ordering of situations is accomplished only once: then using the selected 16 situations, for each of nine forecasts the optimum subsets are computed by the ordered minimization method. The results of the tests indicated that the predicted daily temperature variation coincides closely with the actual curve of temperature change. The temperature change curves were used in computing the minimum nighttime temperature and the maximum daytime temperature. The quality of the forecasts made using the piecewise-constant model considerably surpasses the quality of the forecasts obtained by the analogues method with respect to both forecasts of the nighttime minimum and predictions of the daytime temperature maximum.
[106]

CRITERION FOR EVALUATION OF BAROTROPIC MODELS

[Article by Abdel' Vakhab, Moscow State University, "Conservation of Adiabatic Invariants as a Criterion for Evaluating Barotropic Models"]

[Abstract] There are two types of criteria for evaluating prognostic models.
One of these is the statistics of the success of a forecast. Another type
of criterion is internal relative to numerical models. For example, by having a precise solution of the forecasting equations, it is possible to compare it with a numerical solution. Very important criteria are obtained
from the conservation laws, which are satisfied precisely for the differential forecasting equations. In a three-dimensional case A. M. Obukhov (METEOR-OLOGIYA I GIDROLOGIYA, No 2, 3, 1964) proposed a study of the mass distribution function using two invariants -- potential temperature and potential
vorticity. G. Hollmann (ARCH. METEOROL. GEOPHYS. BIOCL., 14, Heft 1, 1964)
proposed still another set of invariants for a three-dimensional case. In
a barotropic case, in addition to vorticity there is also some analogue
of the Hollmann invariant. In this article it is shown that it is possible
to study mass distribution using this invariant and also the distribution
on the basis of two invariants. The criterion for evaluating the model is
the checking of the conservative properties of these distributions. It is
shown that the method is sensitive to the shortcomings of the numerical
model, especially allowance for the Hollmann invariant. The author gives
a comparison of two numerical models, one of which is a simple quasigeostrophic model with an approximation of the first order of accuracy, that is, with
extremely great smoothing. The second was carried out using a primitive model with a second order of accuracy. As shown in this paper, an evaluation of
these models using the Hollmann invariant gives very different results. The
author discusses a method for obtaining the trajectories of particles on the
basis of their two invariant coordinates: vorticity and the Hollmann invariants.
[198]

USE OF LASERS IN ATMOSPHERIC STUDIES

[Article by V. Zuyev, Corresponding Member USSR Academy of Sciences, "Laser
Investigates the Atmosphere"]

[Summary] Laser rays can be used for collecting and transmitting data on
pressure, density, temperature, humidity, wind, clouds, aerosols and other
atmospheric parameters. The radiation frequency of a laser is a million or
more times greater than the frequency of the radio wave range. This means

that the quantity of different information which can be transmitted by a
laser ray is much greater than is possible with radio waves. A great advan-
tage of laser radiation is the possibility of transmitting information over
extremely great distances. It is possible to measure distances with an ac-
curacy to hundredths of a micron. One such laser method is being investigat-
ed at the Institute of Atmospheric Optics at Tomsk. Among the advantages of
the laser method is the speed with which data are collected from different
points in the atmosphere. The signal is propagated with the speed of light
and data are processed at once on an electronic computer. An original meth-
od developed at the institute makes it possible to evaluate differentially
the contribution of the principal atmospheric components to the attenuation
of the laser ray. Still another laser sounding method is based on measure-
ment of a reflected echo signal caused by light scattering on air molecules.
Workers at Tomsk Institute are working in a new building, a white three-story
structure on the high right bank of the Tom River. On the broad terrace of
the upper floor they sometimes roll out their lidar equipment and measure
density, temperature and pressure in the lower layers of the atmosphere and
determine the lower boundaries of cloud layers, liquid water content of the
lower part of the clouds, vertical profile of the moisture content of the
subcloud layer of the atmosphere. Many times expeditions of Tomsk scientists
have gone to different regions of the country where they investigated indus-
trial contamination of the atmosphere. The experience of the Siberian sci-
entists has shown that even now they can successfully monitor the state of
the atmosphere over the industrial centers of the country. It has been pos-
sible to determine the sources of dangerous contaminants and to evaluate
their role in atmospheric turbidity at different altitudes. Lasers can also
be used to detect gas components. Instruments can be created for finding
gas deposits in the taiga and in swamps and warning of breaks in gas lines.
[179]

CIRCULATORY PROCESSES DURING SPRING-SUMMER DROUGHTS IN USSR

[Article by G. N. Vitvitskiy, Geography Institute USSR Academy of Sciences,
"Macrocirculation Processes During the Period of Spring-Summer Droughts in
the European Territory of the USSR"]

[Abstract] An effort was made to find some correlation between macrocircul-
ation processes and spring-summer droughts in the European territory of the
USSR. The period 1899-1972 was investigated. It was found that during both
arid and in other years there is almost an identical variety of elementary
circulation mechanisms. Thus, with respect to macrocirculation processes
the arid years differ little from the other years. In other words, macro-
scale processes in the northern hemisphere can be only a potential cause
of the appearance or persistence of spring-summer drought in the steppe

and wooded steppe zones. The climatic fields of the elementary circulation
mechanisms can be regarded as models relating the distribution of tempera-
ture, precipitation, cloud cover, etc. with the system of air currents in
a particular circulation mechanism. Therefore, these models were used as
a basis for analysis of atmospheric circulation as a climate-forming factor.
It was found that on the average, in arid years there ris no clear predom-
inance of some macroprocesses over others. Maps in the text show zonal
macrocirculation processes in the European USSR, impairments of zonality,
and meridional macrocirculation processes in the European USSR. It is in-
dicated that in no elementary circulation mechanism is there the dry weath-
er with few clouds which is characteristic of droughts. Nor does the dura-
tion of elementary circulation mechanisms have a direct relationship to
a paucity of precipitation. Data for the period prior to 1918 reveal a
predominance of meridional circulation with only two spring-summer droughts.
This was followed by a long period of zonal circulation lasting for 37
years from 1919 to 1955 with 9 arid years. Meridional circulation regained
force beginning in 1956. In 17 years there were four spring-summer droughts.
In two almost equal time intervals nine droughts were associated with a
dominance of zonal processes in the entire hemisphere and six were assoc-
iated with meridional processes. In the second meridional epoch, shorter
than the first, there were twice as many severe droughts. They obvious-
ly are becoming more frequent. It can be postulated that anthropogenic fac-
tors are becoming increasingly important in the process of drought forma-
tion.
[180]

TURBULENT CONVECTION IN NONDIFFUSIONAL APPROXIMATION

[Article by V. Ye. Shapiro and V. M. Loginov, Siberian Division, Physics
Institute USSR Academy of Sciences, "Turbulent Convection in a Nondiffus-
ional Approximation"]

[Abstract] A study was made of the correlation between the Lagrange and Eu-
ler characteristics of turbulence in a model in which the turbulent field
of velocities of the medium is represented by a non-Gaussian random process
with a finite correlation time. Within the framework of the model it was
possible to obtain a structurally simple system of equations for the aver-
aged motions of liquid particles. The equation of turbulent transfer of
particles under definite conditions is transformed into the well-known dif-
fusion equation with finite velocity. The model is applied to an analysis
of the drift of particles in a turbulent flow with a transverse shear. The
authors describe singular convection caused by nonuniformity of the fluc-
tuations field. The article gives a comparison of theory with experimental
data on diffusion in the atmospheric surface layer.
[214]

VERTICAL DISTRIBUTION OF ATMOSPHERIC OZONE

[Article by P. F. Boychenko, Central Aerological Observatory, "Some Correlations Between the Vertical Distribution of Atmospheric Ozone and the Thermodynamic Parameters of the Atmosphere"]

[Abstract] Information is presented on the vertical distribution of ozone obtained using observations of the umkehr effect at Volgograd during the autumn of 1974 and the summer of 1975. These umkehr data were used for an analysis of the day-to-day variations of the distribution of the density of atmospheric ozone in relation to some meteorological parameters (distribution of temperature, atmospheric circulation, vertical movements and individual solar activity indices). For example, it was found that the ozone distribution at the levels 65 and 50 km duplicates the solar activity curve with a period of about 27 days. On these curves there are also variations with a higher frequency (with a period of 3-5 days). The period equal to the 27-day solar cycle evidently indicates a direct influence of solar activity on the magnitude and fluctuations of density of ozone at great altitudes. The high-frequency component is a result of the influence of a combination of thermodynamic factors. Near 40 km the direct influence of solar activity and the indirect influence of atmospheric circulation on the density of atmospheric ozone are probably cancelled out by one another; there is no 27-day cyclicity in the variation of ozone density. At levels situated below 34-24 km the 27-day cyclicity is again clear with a phase shift from level to level. At 22 km in the region of maximum ozone density the picture is similar to that at 40 km. Below the level of maximum ozone density (20-16 km) the solar cycle is possibly expressed even more clearly than in the upper stratosphere and lower mesosphere with a phase shift from level to level.
[214]

III. OCEANOGRAPHY

News

NEW SIGNAL AND WARNING SYSTEM FOR TSUNAMIS DEVELOPED

[Article by K. Kanishchev, "Attention, Tsunamis are Coming"]

[Text] Petropavlovsk-Kamchatskiy, 1 August. Here at the "Tsunami" station an automatic signal and warning system for gigantic tsunami waves has begun operation.

Until now tsunami warnings were transmitted to a telegraph and then to regional centers. Now if danger arises the person on duty at the station presses keys "Ust'-Kamchatsk" and "Nikol'skoye" on a panel and in a few moments a radio signal reaches the designated place. Then in Nikol'skoye on Bering Island and in Ust'-Kamchatsk an alarm signal sounds through a radio relay network. [5]

Abstracts of Scientific Articles

INTERPRETATION OF DATA FROM HYDROMAGNETIC SURVEYS AT SEA

[Article by V. N. Strakhov and G. M. Valyashko, Institute of Physics of the Earth, "Method for Routine Interpretation of Data from Hydromagnetic Surveys at Sea"]

[Abstract] A method for the routine interpretation of data from hydromagnetic surveys in the ocean should be based on a model of the observed field ΔT in the form of the additive sum of the useful signal and random (uncorrelated) noise, not on application of far-going hypotheses concerning the structure of the investigated medium. The basis of the method is procedures of transformation of the observed field, both linear and nonlinear. Taking into account the profile nature of the surveys, such procedures can be formulated on the basis of the plane problem theory. However, in interpreting the results it is necessary to take into account the three-dimensionality of the real field. This can be achieved by using the concept of "intersection of fields" proposed by V. N. Strakhov (IZV. AN SSSR, FIZIKA ZEMLI, No 6, 1976). In this article the theory is reviewed, followed by derivation of formulas which make solution of this problem possible. The interpretation method described here was tested in a number of model and practical examples. Figure 1 gives the results of analytical continuation of the model ΔT field in a series of curvilinear levels above the relief of the upper edge of the magnetically active layer formed by a set of directly and inversely magnetized blocks. Figure 2 gives the results of computations along a profile intersecting the rift zone of the Mid-Atlantic Ridge in the neighborhood of 23°N. [173]

DESTRUCTION OF KNOIDAL INTERNAL WAVES IN OCEAN

[Article by Ye. N. Pelinovskiy and S. Kh. Shavratskiy, Gor'kiy Scientific Research Radiophysics Institute, "Destruction of Knoidal Internal Waves in a Horizontally Inhomogeneous Ocean"]

[Abstract] This is essentially a continuation of an earlier article by the authors (IZV. AN SSSR, FIZIKA ATMOSFERY I OKEANA, 12, No 1, 1976). There they examined the change in the parameters of a knoidal internal wave in a horizontally inhomogeneous ocean. It was demonstrated that with a decrease in the nonlinear parameter the form of the stationary wave approaches sinusoidal (however, it was not possible to examine the passage of the wave through the region of change in the sign of the nonlinearity within the framework of stationary waves). In this new paper it is shown that a knoidal wave cannot pass through a region of change in sign of the nonlinearity and remain stationary. Instead of a stationary picture, in this region with an increase in σ there will be strong beats of the spectral components. It is evident that this result is not dependent on the initial sign of σ. Thus, there is an additional mechanism for the destruction of stationary waves which to a definite degree can limit the region of their existence. [198]

EFFECT OF SUBMARINE CANYONS ON SHORELINE DYNAMICS

[Article by G. A. Saf'yanov, Geomorphology Department, Moscow University, "Influence of Submarine Canyons on Shoreline Morphology and Dynamics"]

[Abstract] Three types of submarine canyons can be differentiated on the basis of the manifestation of lithodynamic processes: 1) mouth canyons which receive alluvium from the sediments of rivers; 2) canyons with lateral supply of material arriving from the shoreline during its movement along the shore; 3) canyons of the mixed type. The influence of submarine canyons on the shore zone is exerted through changes in the hydrodynamic structure of the wave field and corresponding changes in the conditions for the movement of sediments and also directly by an irreversible removal of part of the sediments and their transport beyond the limits of the shoreline. This phenomenon is illustrated by data for many rivers in the USSR and abroad. It is pointed out that data on the influence of submarine canyons on the shoreline can be used for selecting methods for shore reinforcement in regions subject to the negative influence of submarine canyons, in hydraulic construction on rivers whose solid runoff is lost in the canyons, for contending with the silting-in of approaches to ports, rational exploitation of underwater placers in the shore zone and formulation of measures for contending with underwater erosion, for the purposes of underwater navigation and implementation of engineering projects in submarine canyons in the shore zone, description and prediction of contamination of the bottom layer of the world ocean arising due to runoff of contaminants through the canyons from the shore zone and river channels. [190]

GEOMORPHOLOGICAL RESEARCH IN DEEP OCEANOLOGICAL WORK

[Article by I. P. Gerasimov, Geography Institute USSR Academy of Sciences,
"Geomorphological Investigations in the System of Abyssal Oceanological
Work (Status, Methods, Objectives)"]

[Abstract] On the basis of data from the 24th voyage of the scientific re-
search ship "Akademik Kurchatov" in the Atlantic and Pacific Oceans the
author analyzes the peculiarities of methods used in geomorphological in-
vestigations of the ocean floor, modern concepts concerning its relief,
and formulates some problems in the further development of geomorpholog-
ical investigations in the system of deep-water oceanological work. Con-
siderable detail is given concerning the following: general characteristics
of geomorphological investigations in the system of oceanological work,
Azores region, profile run across the Atlantic Ocean, polygon in the "At-
lantis" fault, polygon in the Atlantic rift zone, Caribbean Basin region
and Galapagos area. It was demonstrated clearly on this voyage that the
programs of geological-geophysical work during deep-water oceanological
investigations must include investigations on ocean islands. The combin-
ation of geomorphological investigations with geophysical and geological
studies can serve as an example for subsequent oceanic and surface geo-
morphological and geological investigations.
[180]

DIFFERENCE SCHEMES FOR SEA CURRENT COMPUTATIONS

[Article by V. F. Kozlov, Far Eastern State University, "Use of Monotonic
Difference Schemes in Diagnostic Computations of Sea Currents"]

[Abstract] For numerical solution of an equation determining the integral
stream function, surface or bottom pressure, the author proposes a class
of monotonic difference schemes whose approximated viscosities are functions
of the generalized Reynolds difference numbers. The author has established
the order of the approximation and the stability of the considered schemes.
Also given are the results of numerical experiments with model problems
and for specific physiographic conditions.
[214]

CORRELATION BETWEEN HEAT FLOW AND TEMPERATURE GRADIENT AT SEA

[Article by S. G. Boguslavskiy and A. I. Fel'zenbaum, Institute of Ocean-
ology, "Correlation Between the Heat Flow and the Temperature Gradient at
Sea"]

[Abstract] In formulating a model of general circulation in the ocean it
is necessary to establish a correlation between the temperature gradient
and the vertical turbulent heat flow (see S. A. Arsen'yev, et al., DAN,
Vol 225, No 1, 1975; S. G. Boguslavskiy, MORSKIYE GIDROFIZICH. ISSL., No
5, 1971). This flow is dependent on a series of factors, of which the most
difficult to take into account is heat advection under nonstationary con-
ditions. However, for individual regions in which there are no intensive
currents and the weather is relatively stable, it is dependent for the
most part on the vertical temperature gradient. This dependence can be
established using data from hydrological observations. As an example, the
authors discuss the central part of the Black Sea and the northern part
of the Sea of Japan during the spring-summer heating of waters when the
weather is usually stable, currents are weak and the vertical temperature
gradient is already quite great and is measured with a minimum relative
error. For these regions and the indicated season on the basis of climat-
ological data it was possible to construct graphs of the annual variation
of temperature and its vertical gradient at a depth of 10 m. Below this
horizon it was possible to compute the heat content of the active layer.
If it is assumed that in a unit time the change in the heat content is
equal to the heat flow through the upper boundary of the active layer, the
resulting data, as illustrated here, make it possible to find a correla-
tion between the heat flow and the vertical temperature gradient. (This
correlation is indicated in Figure 1 for the Black Sea and the Sea of Jap-
an.)
[215]

MODEL OF A BAROCLINIC OCEAN

[Article by V. K. Kosnyrev, Yu. M. Kuftarkov and A. I. Fel'zenbaum, Marine
Hydrophysical Institute Ukrainian SSR Academy of Sciences and Institute of
Oceanology, "One Model of a Baroclinic Ocean"]

[Abstract] On the basis of the work of G. A. Needler ("A Model for Thermo-
cline Circulation in an Ocean of Finite Depth," J. MARINE RES., 25, 3, 1967)
the authors have formulated a temperature model describing the thermocline

both in the middle latitudes and at the equator itself. The paper presents the results of computations of the temperature of the ocean surface for the northern part of the Pacific Ocean. These results are shown in Fig. 4. It is seen that as they run from west to east in the northern part of the region the isotherms rise, whereas in the southern part they for the most part descend. In the equatorial region in the eastern part of the ocean there is a marked change in temperature. In general, the indicated behavior of the isotherms is close to that observed. An analysis shows that after the temperature is determined it is possible to compute the level and all three components of current velocity. This is a diagnostic problem and essentially involves computation of the integral stream function in dependence on the wind, bottom relief and the determined temperature field.
[214]

STRUCTURE OF COLD SURFACE FILM OF OCEAN AND HEAT EXCHANGE

[Article by G. G. Khundzhua, A. M. Gusev, Ye. G. Andreyev, V. V. Gurov and N. A. Skorokhvatov, Moscow State University, "Structure of the Surface Cold Film of the Ocean and Heat Exchange Between the Ocean and the Atmosphere"]

[Abstract] Specialists in the Department of Physics of the Sea and Waters of the Land in the Physics Faculty of Moscow State University have developed and constructed a complex of high-speed electronic computers for registering the temperature profile in the thin surface layer of the sea by the method of vertical sounding of fluctuations of temperature and the current velocity components in the surface layer of the sea and also the temperature of the sea surface using an infrared radiometer. The temperature profile in the thin surface layer of the sea was registered by the vertical sounding method. The sensor used was a differential copper-constantan thermocouple. Sounding was by command from aboard the ship at a constant rate of 17 cm/sec, beginning with a height of 30 cm above the sea surface and to a depth of 30 cm. The signal from the sensor, proportional to the temperature difference, after preamplification was registered on an electronic oscillograph. The accuracy in registering the temperature difference was 0.05°. The results of expeditions in the Black Sea during 1971-1975 are considered. It was found that at the sea surface there is a laminar layer with a thickness of 0.2-0.6 mm. Data are given on the diurnal variation of the total density of the heat flow from the sea to the atmosphere and the temperature of the sea surface.
[214]

COINCIDENCE OF BOUNDARIES OF WATER MASSES AND BOTTOM SEDIMENTS

[Article by K. V. Beklemishev, A. N. Pantyulin, N. L. Semenova and F. A. Shcherbakov, Moscow State University, "Coincidence of Boundaries of Water Masses and Bottom Sediments in Kandalakshskiy Gulf of the White Sea"]

[Abstract] In the summer of 1975 in the open part of Kandalakshskiy Gulf specialists aboard a vessel of the White Sea Biological Station of Moscow University made four runs across the gulf and occupied 58 stations. At each station the bottom fauna was collected and temperature and salinity of the bottom water was measured and samples of sediments were taken for a granulometric analysis. The three water masses of the White Sea correspond to three levels of bottom communities. A study of the vertical distribution of the individual species of bottom animals in dependence on the distribution of bottom T,S pairs made it clear that there are species strictly associated with one water mass, species encountered in two water masses, and those present in all three. However, it was found that in the investigated region of the Black Sea the boundaries of the water masses and bottom sediments to a considerable degree coincide with one another. This circumstance is of great importance for clarifying the influence of hydrological and geological factors on the distribution of water animals. The data from this study show that the boundaries of water masses and types of sediments can coincide. Therefore, in a study of the distribution of bottom animals in dependence on the abiotic factors of the medium it is necessary to take into account the relative distribution of water masses and bottom sediments. Otherwise, the conclusion that individual species are associated with definite water masses or definite types of sediments can be erroneous. [213]

QUASIHOMOGENEOUS LAYER IN THEORY OF OCEANIC CIRCULATION

[Article by V. K. Kosnyrev, Yu. M. Kuftarkov and A. I. Fel'zenbaum, Institute of Oceanology, "Quasihomogeneous Layer in the Theory of Oceanic Circulation"]

[Abstract] With the incorporation of a quasihomogeneous layer in a model of oceanic circulation temperature can be considered either a continuous function of the vertical coordinate from the ocean surface to the bottom or a discontinuous function at the boundary with the thermocline. In the second case, which is discussed here, the jump layer is modeled by the introduction of the temperature inhomogeneity. (Earlier this case was examined under conditions of horizontal homogeneity.) The theories and formulas presented here, representing a further development of the earlier work, show that the processes of a synoptic scale in a quasihomogeneous

layer transpire with a "frozen-in" temperature profile in the thermocline.
[215]

DISTRIBUTION OF CASPIAN WATERS STUDIED USING IR AERIAL SURVEY

[Article by B. V. Shilin and V. N. Gruzdev, "Distribution of Caspian Waters in Karabogazgol Gulf Using Materials from an IR Aerial Survey"]

[Abstract] For the purpose of obtaining objective data on the distribution of the waters of the Caspian in Karabogazgol Gulf, specialists of the Aerial Methods Laboratory of the USSR Geology Ministry in 1975 carried out an IR aerial survey of the coastal part of the gulf. A factor of particular importance was the known fact of an appreciable difference between the water temperatures of the Caspian and the gulf. The IR aerial survey was carried out during the daytime and nighttime from an altitude of 1,500- 2,000 m; this made it possible to obtain IR photographs at scales of 1:25,000-1:40,000. The results of the survey made it possible to compile a composite map of the distribution of water masses in this area for 2 November 1975. The map shows that an IR aerial survey is highly effective as a new, rapid synoptic method for the mapping of the boundaries of different water masses. It is clear that the distribution of Caspian waters in the gulf changes considerably with time and this explains the observed variations in the hydrochemical regime of individual parts of the gulf. The waters of the Caspian move in the gulf in a uniform flow with sharp boundaries without their separation into southerly and northerly branches. It is concluded that a periodic IR aerial survey in combination with surface temperature, hydrochemical and hydrometeorological observations can become an effective means for studying and predicting the state of Karabogazgol Gulf as an extremely large and unique deposit of mineral salts.
[215]

ORIGIN OF ABYSSAL DEPRESSIONS IN SEA OF OKHOTSK AND SEA OF JAPAN

[Article by I. A. Rezanov, All-Union Scientific Research Institute of Nuclear Geophysics and Geology, "Origin of Abyssal Depressions in the Sea of Okhotsk and Sea of Japan"]

[Abstract] The article begins with a description of the geological history and structure of the Sea of Okhotsk and Sea of Japan. All evidence indicates that these were formed recently. The onset of formation of its individual downwarps occurred in the Miocene and in the first half of the

Pliocene and the formation of the depression in its modern form was completed only in the Quaternary. The structural position of the Sea of Okhotsk and the Sea of Japan depressions in the Pacific Ocean folded belt is discussed in detail. The mechanism of formation of these abyssal depressions is considered in detail. All available data are interpreted, for example, heat flows and anomalies of absorption of longitudinal waves in the upper mantle. All data indicate a recently beginning (in the Miocene) and actively continuing process of subsidence of the Sea of Okhotsk and Sea of Japan depressions. After integrating the data already available (22 sources are cited) the author suggests the advantages to be obtained from further drilling, dredging and other exploration techniques.
[210]

METHODS FOR GEOCHEMICAL PROSPECTING OF COASTAL MARINE DEPOSITS

[Article by B. S. Kogan, All-Union Scientific Research Institute of Marine Geology, "Methods for Geochemical Prospecting of Coastal Marine Placers"]

[Abstract] In illustrating the effectiveness of use of different geochemical methods for prospecting coastal marine deposits, the author describes experimental geochemical investigations in a coastal area of the USSR where placer gold is associated primarily with thin (0.5-2.0 m) coarsely granular marine deposits underlying the bottom of a bay. Among the findings were the following. The mechanical aureole of the main placer-forming metal and satellite elements forming together with the placer is related to the distribution of minerals of the heavy fraction and can have a zonal structure. In this case the patterns of distribution of the elements in the marine sediments are regulated by the aggregate state and physicochemical properties of the concentrating minerals migrating in the hydrodynamic wave field. Since the present state of knowledge for the time being does not make it possible in the interpretation of geochemical data to use the usual analogues method and any newly discovered anomaly in principle can differ unpredictably from the patterns described in the article, in each specific case by means of a comparison of the averaged experimental data from mineralogical and geochemical analyses it is necessary to ascertain the differential mobility of the elements in the sea medium where the placer is formed. It is necessary to carry out geochemical investigations for discriminating true geochemical anomalies associated with increased concentrations of heavy fraction minerals. Already in the current stage of investigations of the shelf geochemical methods can be used successfully in the search for recent marine placers of heavy metals forming in the upper layers of coastal marine deposits. In the future, with refinement of concepts on the vertical zonality of placer deposits these methods will undoubtedly be promising for the prospecting of buried placers as well.
[210]

REVIEW OF IMPORTANCE OF STUDY OF SOUND IN THE OCEAN

[Article by Academician L. M. Brekhovskikh, "Sound in the Ocean"]

[Abstract] The reasons for the current stress on marine acoustics is empha-
sized in this review of sound in the ocean. The following subjects are cov-
ered: sound absorption in sea water, natural underwater noise of the ocean,
sound scattering layers, sound scattering by the ocean surface, acoustics
of the ocean floor, sound propagation over great distances, sonic waves and
vertical fine structure in the ocean, and the future of acoustic methods.
The future exploitation of ocean depths, the discovery and use of mineral,
biological and energy resources will require new methods and equipment for
underwater observations, direction finding, telecommunication and other
purposes. With few exceptions all this apparatus and methods will be acous-
tic. For weather forecasts, for example, it is necessary to know better the
dynamics of water masses in the ocean. For understanding the geological na-
ture of the planet and investigating mineral resources there must be a know-
ledge of the structure of the ocean floor at great depths, and acoustic
methods are the best for this purpose. The only way to fill the gap between
the available and required information concerning the ocean is the active
introduction of remote methods. There can be two mutually supplementing
methods: the first is the use of satellite information on the ocean surface
and the atmosphere above it and the second is investigation of the structure
and movement of water masses in the ocean by use of acoustic or anchored
buoys. It is an attractive idea to relay information concerning the ocean
to a satellite using the acoustic waves from beneath the water. But less
than a thousandth of the energy of the acoustic wave reaching the water sur-
face penetrates into the air. This article thus generalizes the information
available on this underdeveloped field.
[217]

STABILITY OF ZONAL FLOW WITH LINEAR VELOCITY PROFILE

[Article by V. V. Ditkin, Yu. A. Ivanov and V. I. Ul'yanova, Institute of
Oceanology, "Stability of Zonal Flow with a Linear Velocity Profile in an
Inhomogeneous Ocean"]

[Abstract] A study is made of a model of the stability of a zonal geostroph-
ic flow with a constant vertical velocity shear. The model is presented
numerically for different values of the parameters of the basic state. The
authors investigate the behavior of the phase velocities, increments and

eigenfunctions of unstable perturbations in the parameters of the basic state and wave number. Comparison of the results with experimental data shows that the periods and wavelengths of the most rapidly increasing perturbations are close to the characteristic spatial and temporal scales of mesoscale perturbations observed in the open ocean. The change in phase of unstable waves with depth is also in qualitative agreement with direct measurements. These results make it possible to assume that baroclinic instability can make a considerable contribution to the formation of energy-carrying mesoscale perturbations in the open parts of the world ocean. [214]

IV. TERRESTRIAL GEOPHYSICS

News

REVIEW OF SOVIET PARTICIPATION AT INTERNATIONAL GEOGRAPHICAL CONGRESS

[Article by V. D. Bykov, A. G. Voronov, G. M. Ignat'yev, G. I. Lazukov and
V. N. Solntsev, Departments of Hydrology of the Land, Biogeography, Gener-
al Physical Geography and Paleogeography and Physical Geography of Foreign
Countries, "Physical Geography at the 23d International Geographical Con-
gress (28 July-3 August 1976, Moscow)"]

[Abstract] The Twenty-Third International Geographical Congress was held
in Moscow in July-August 1976 and was dedicated to the theme "Geography
and the Scientific-Technical Revolution." This report very briefly summar-
izes the papers presented by both Soviet and foreign scientists in the fol-
lowing sections: Geomorphology and Paleogeography, Geomorphology, Paleogeo-
graphy, Climatology, Hydrology and Glaciology, Geography of the Ocean, Bio-
geography and Soils Geography, General Physical Geography. Many of the re-
ports by Soviet researchers were characterized by the formulation of broad
and important problems and suggested promising approaches for their solution.
The authors draw preliminary conclusions concerning the trends in the de-
velopment of contemporary geographical thought. An example of the nature
of this summarization is the reports given on geography of the ocean. (This
section was created on the initiative of Academician K. K. Markov.) A. S.
Monin familiarized the listeners with the matters which are to be examined
in a multivolume study of the oceans prepared by the Institute of Oceanol-
ogy. Reports by A. D. Dobrovol'skiy and others examined the principal pat-
terns of spatial differentiation of the nature of the ocean. They demon-
strated the exceptionally important role of boundary surfaces in geochem-
ical and biological processes in the ocean and also the importance of
large water circulations as the principal links in regional systems in the
ocean. Some reports dealt with the geographical zonality of the ocean. O. K.
Leont'yev examined the patterns of tectonic development and formation of
relief in the transition zones from the continents to the ocean. The morpho-
structures of the bottom of the southeastern part of the Pacific Ocean

were discussed in a report by A. V. Zhivago. Other reports concerned the interrelationship between the relief of islands and tectonic movements, as well as the geomorphology of shores. Still other reports dealt with the economic geography of the world ocean, its basic problems (S. S. Sal'nikov), peculiarities of attraction of the population toward sea shores, problems of the southern seas of the USSR (V. I. Lymarev).
[190]

SEISMIC STATION BEGINS OPERATION IN TURKMENIA

Moscow PRAVDA in Russian 29 Jul 77 p 6

[TASS Report: Untitled Article]

[Text] In the foothill plains of the Kopetdag a portable seismic station has begun operation. This station is the first one in Turkmeniya and will register possible underground tremors in the area of the new Kopetdag Reservoir. According to scientists, artificial seas can be sources of shifts in the earth's core. [5]

Abstracts of Scientific Articles

ESTIMATE OF EQUILIBRIUM TEMPERATURE AT EARTH'S CENTER

[Article by A. T. Aslanyan, Institute of Geological Sciences, Armenian SSR, "One Possibility of Evaluating the Equilibrium Temperature at the Center of the Earth"]

[Abstract] The author examines the state of matter in the earth's inner core, using the Clapeyron equation as a point of departure, in order to estimate the equilibrium temperature at the earth's center. Formulas are derived which make it possible to ascertain equilibrium T in a hypocentral solid core and at the distance r from its center. For the center of the earth (r = 0) the equilibrium temperature $(T_e)_c$ = 7,500°K, whereas for the surface of the central core, at the distance 1,280 km from the center, T_e = 7,200°K. The temperature T_c = 7,500°K corresponds to a pressure at the earth's center P_c = $4.03 \cdot 10^{12}$ dynes/cm^2 and a density ρ_c = 12.87 g/cm^3. All the atoms in the formulated model are completely ionized; the electron gas is in a degenerate state and the decisive contribution to the thermal pressure is from stripped atomic nuclei which in a sea of degenerate electron gas behave like atoms of an ideal gas having three degrees of freedom of translational motion.
[113]

EQUIVALENCE IN PLANE PROBLEM OF GRAVIMETRY WITH VARIABLE DENSITY OF MASSES

[Article by V. N. Strakhov, Institute of Physics of the Earth, "Equivalence in the Plane Problem of Gravimetry with a Variable Density of Masses"]

[Abstract] The author proposes a new tool for investigating the problem of the equivalence of the plane inverse problem of gravimetry with variable (analytical) densities, the so-called procedure of "sweeping" of masses from region to region. (This concept was introduced by Poincaré; it is reviewed and elaborated here.) A model of this procedure is formulated and

its nonuniqueness is established. The procedure is used in demonstrating the validity of a series of theorems of equivalence and on this basis a series of methodological conclusions is drawn.
[165]

PREDICTION OF ROCK DESTRUCTION

[Article by S. N. Zhurkov, V. S. Kuksenko, V. A. Petrov, V. N. Savel'yev and U. Sultanov, Physical-Technical Institute, "Prediction of Rock Destruction"]

[Abstract] The method of emission of elastic waves was used in a study of the kinetics of accumulation of fractures in rocks when they are exposed to uniaxial compression. The authors analyze the dependence between the amplitude of the signal, proportional to the size of the fracture, and the number of signals, proportional to the number of fractures; the analysis is based on data on size and critical concentrations of the fractures forming in polymer materials. The article discusses the possible application of kinetic concepts and the patterns of accumulation and interaction of fractures in loaded bodies in the processes of large-scale unloading (relaxation) lying at the basis of phenomena leading to rock collapse and earthquakes.
[216]

CONVECTIVE INSTABILITY OF MULTILAYER MODELS OF MANTLE

[Article by B. I. Birger and S. G. Shlesberg, Institute of Physics of the Earth, "Convective Instability of Multilayer Models of the Earth's Mantle"]

[Abstract] The article gives a solution of the problem of convective instability in a horizontal layer of an incompressible fluid heated from below. A solution is proposed for a case when the viscosity is a power function of depth. The author visualizes the earth's mantle as a horizontal layer of incompressible fluid whose viscosity is a power function of the vertical coordinate and using the Boussinesq approximation examines the problem in detail. It is shown that within the framework of this model it is impossible to obtain a horizontal dimension of the convective cell of 5-10 thousand kilometers which would correspond to the dimensions of lithospheric plates.
[216]

MULTIPLE SCATTERING IN FORMATION OF TAIL PART OF SEISMOGRAM

[Article by Yu. F. Kopnichev, Institute of Physics of the Earth, "Role of
Multiple Scattering in Formation of the Tail Part of a Seismogram"]

[Abstract] On the assumption of isotropicity of scattering, the author has
derived in explicit form expressions for the intensity of doubly and triply
scattered waves forming the seismogram code. The article examines cases of
scattering of surface and body waves. The energy of the multiple scattered
waves attenuates with time more weakly than the energy of singly scattered
waves. The limits of applicability of the theories of single and diffuse
scattering are stated. The theory of diffuse scattering used in the analysis
of lunar seismograms is defined. It is shown that the theory of diffuse scat-
tering is not applicable under terrestrial conditions.
[216]

REGIONAL INVESTIGATIONS OF CRUST AND UPPER MANTLE

[Article by S. A. Kats, T. N. Yershova, N. G. Mikhaylova, A. V. Yegorkin and
V. N. Uteshev, Institute of Physics of the Earth, "Nonlinear Interference
Analysis of Seismic Materials from Regional Investigations of the Crust and
Upper Mantle"]

[Abstract] The objective of this study was an interpretation of the complex
wave pattern in zones of interference of waves propagating in the earth's
crust and upper mantle. A method is described for discriminating waves
against a background of interference using nonlinear interference systems.
The authors determined the specific processing parameters necessary for the
reliable discrimination of waves when using observation systems with a ·
small number of channels on long bases. As a result of the processing, in a
time interval with a duration of 12 sec from the first arrivals in the com-
plex interference field it was possible to trace stable waves correlating
at a distance of 50 or more kilometers with different apparent velocities.
Most of these waves, which carry information on the structure of the sedi-
mentary stratum, crust and upper mantle, were not discriminated in visual
correlation. In the example of an analysis of the wave field in the region
of registry of a wave reflected from the Mohorovicic discontinuity it was
demonstrated that the reason for the impairment of correlation of the P_{refl}^{M}
wave is interference waves in a broad range of apparent velocities (6.3-9.0
km/sec). The results make it possible to recommend the proposed method for
the discrimination of waves on the basis of velocities for extensive use

in practical investigations of the crust and upper mantle. Further prospects
for development of the method are the directional discrimination of waves of
different types and especially the field of reflected waves on the basis of
effective velocities, which will make possible a more detailed breakdown
of the crust and upper mantle on the basis of velocities.
[216]

CONDUCTIVITY OF THE OCEANIC ASTHENOSPHERE

[Article by L. L. Van'yan, Ye. P. Kharin, I. L. Osipova and V. A. Spivak,
Institute of Oceanology and Interdepartmental Geophysical Committee, "Con-
ductivity of the Oceanic Asthenosphere Near the California Coast"]

[Abstract] Although data have been obtained on the conductivity of the as-
thenosphere beneath the continents, little is known about conductivity un-
der the oceans. Technical difficulties prevent the extensive use of the mag-
netotelluric and magnetovariation gradient method which was developed es-
pecially for sea conditions. For the time being the only example of the com-
bined use of these methods for a broad interval of periods of variations
(0.5-24 hours) is a study by J. C. Larsen, et al. (JGR, 71, 4441, 1966) made
on the Pacific Ocean floor near California. These data have now been used
as basic data for this study and the results of observations at other sta-
tions are used for corrections. It is concluded that the well-conducting
layer of the oceanic asthenosphere at depths of 70-170 km, having a resis-
tivity of 2-3 ohm·m, can be discriminated by gradient magnetovariation sound-
ing in the range of periods 0.5-24 hours. This model is confirmed by phase
measurements by the magnetotelluric sounding method. Amplitude measurements
for the range of periods $0.5 \leqslant T \leqslant 6$ hours are too low. The resistivity of
upper mantle rocks can be reduced to 2-3 ohm·m as a result of partial melt-
ing. In the western part of the North American continent it is possible to
discriminate a conducting asthenosphere in the depth range 100-200 km with
a resistivity of about 5 ohm·m and a total conductivity of $20 \cdot 10^3$ mho.
[216]

PARAMETERS OF MAGNETOSPHERIC PLASMA DETERMINED FROM "PEARLS"

[Article by K. Dobesh, Yu. P. Kurchashov, V. A. Troitskaya, F. Z. Feygin and
D. S. Fligel', Geophysical Institute, Czechoslovakian Academy of Sciences,
Institute of Physics of the Earth and Institute of Terrestrial Magnetism,
Ionosphere and Radio Wave Propagation]

[Abstract] Presently available data on the position of the source of "pearls" obtained by different methods are contradictory. This paper reviews the sources of information on the site of generation of "pearls." For localizing the region of "pearl" generation the authors use information on the group lag of wave packets during propagation along the magnetic line of force between conjugate points. Table 1, as an illustration, gives examples of determination of regions of generation of "pearls" by different methods for three cases. These were observed for $K_p \sim 3$. The region of generation was situated at a distance $\sim 4R_0$. Estimates of the position of the plasmopause for this disturbance level give values $L \approx 3.5-5.5$. The results convincingly indicate that the region of generation of "pearls" coincides with the region of the plasmopause. Thus, determination of the position of the region of generation of "pearls" is in essence a method for determining the position of one of the most important structural formations in the magnetosphere -- the boundary of the plasmosphere. It was also found that ground observations of "pearls" make it possible to determine the principal parameters of hot protons in the regions of their contact with dense cold plasma.
[218]

THEORY OF ATTENUATION OF EARTH'S TORSIONAL OSCILLATIONS

[Article by S. Ts. Akopyan, V. N. Zharkov and V. M. Lyubimov, Institute of Geophysics and Engineering Seismology, and Institute of Physics of the Earth, "On the Theory of Attenuation of the Earth's Torsional Oscillations"]

[Abstract] The theory of attenuation of torsional oscillations in an inelastic earth was explored in some depth in an earlier study by the authors (IZV. AN SSSR, FIZIKA ZEMLI, No 6, 1977); there, using the theory of perturbations, they investigated steady attenuating oscillations. In this new paper they give a solution of the problem, beginning with excitation of motion by a point source and ending with a steady regime of attenuating oscillations. Until now it has been believed that in addition to attenuating oscillations there can be aperiodic solutions. The analysis presented here indicates that in the case of a Lomnitz rheological body (J. APPL. PHYS., Vol 28, No 2, 1957) there may not be aperiodic solutions.
[218]

ZONALITY OF PRESENT STRESSED STATE OF CRUST AND SEISMICITY

[Article by Ye. S. Shtengelov, Odessa State University, "Zonality of Present Stressed State of the Earth's Crust and Seismicity"]

[Abstract] Investigations made using gamma methods indicated that in all investigated regions, regardless of their tectonic structure and other natural characteristics, there is an alternation of banded zones of horizontal compression and horizontal dilatation. This zonality persists in all deep sections. The considerable frequency of alternation of zones of compression and dilatation and other factors allow only one explanation of the nature of this zonality: a post-orogenic horizontal spreading of the continental crust tangentially compressed during an alpine orogenesis. Within the limits of fragments of the field of orogenic compression, situated between dilatation zones, there is persistence of residual, unrelaxing compressions. There are data indicating that the post-orogenic spreading of the crust is continuing at the present time due to expansion of existing zones of dilatation and the formation of new ones. The continuing spreading of the earth's crust is also indicated by the correlation between geodynamic zonality and sesmicity. For example, in the entire studied region there is a clear correspondence between the contrast of geodynamic zonality and the scale of seismicity. There is a clear correspondence between the azimuths of the axes of seismofocal zones and the directions of the isoseists and the azimuths of dilatation zones. Seismic activity is most significant within the limits of or near large dilatation zones. In the most studied regions the configuration of the fields of maximum seismic activity corresponds to the configuration of the dilatation zones. All this is confirmed by data on hydrogeological and hydrochemical phenomena accompanying earthquakes.
[213]

V. UPPER ATMOSPHERE AND SPACE RESEARCH

News

INTERVIEW WITH ACADEMICIAN G. I. PETROV

Moscow PRAVDA in Russian 13 Jun 77 p 4

[Article by Yu. Zaytsev, "Space -- Far and Near"]

[Summary] In an interview with Academician G. I. Petrov, the following facts and opinions were elicited. Space stations need not necessarily be large. In addition to complex, multipurpose laboratories whose crews will consist of tens of men, there will be relatively small specialized vehicles. These will be necessary, for example, for carrying out precise magnetic and electric measurements free from all kinds of interference which originates from instruments and apparatus aboard a large station. One of the possible directions in the further development of cosmonautics is the creation of repeatedly used apparatus. The space transport system of the future should have a returnable first, and in case of necessity, a second returnable stage. The last orbital stage, the transport ship, in many respects will resemble a modern jet aircraft. In order to increase the payload of such a system it is desirable to use an air-jet engine in the first stage. Multiply used systems can be especially productive in combination with orbital stations in which man can work for some time and then return to earth. The establishing of a manned colony on the lunar surface is not a priority -- there is nothing at present requiring man's prolonged presence on the moon. A long-working lunar expedition would yield less information than a manned circumlunar orbiting station having automatic vehicles capable of descending to the surface. With respect to Mars, man will visit there sooner or later. But first of all it is necessary to solve the problem as to whether there is life on that planet. The best idea is to first return ground from that planet. In addition, many biomedical problems must be solved. There is not yet a competent determination of how long man can stay in a state of weightlessness. (A Martian expedition would last about three years.) Studies must be made to determine the origin of the sun and to investigate the nature of the solid matter scattered in interplanetary space. It is necessary to collect samples of undamaged primary meteor matter. This is evidently possible

by means of the braking of soft meteor particles in a body of extremely low density -- a hundredth of a gram per cubic centimeter. It would also be interesting to study samples of matter returned to the earth from the surface of the asteroids.
[98]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-934"

Moscow PRAVDA in Russian 29 Jul 77 p 1

[TASS Report: "'Kosmos-934'"]

[Abstract] The artificial earth satellite "Kosmos-934" was launched in the Soviet Union on 27 July 1977. The satellite was inserted into an orbit with the following parameters:
    -- initial period, 89.4 minutes;
    -- apogee, 264 kilometers;
    -- perigee, 238 kilometers;
    -- orbital inclination, 62.8 degrees. [5]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-935"

Moscow IZVESTIYA in Russian 31 Jul 77 p 4

[TASS Report: "'Kosmos-935'"]

[Text] The artificial earth satellite "Kosmos-935" was launched in the Soviet Union on 29 July 1977. The satellite carries scientific equipment intended for the continuation of space research. The satellite was inserted into an orbit with the following parameters:
    -- initial period, 89.2 minutes;
    -- apogee, 276 kilometers;
    -- perigee, 225 kilometers;
    -- orbital inclination, 81.3 degrees.

    In addition to the scientific equipment, the satellite carries a radio transmitter operating on a frequency of 19.995 MHz, a radio system for the precise measurement of orbital elements and a radiotelemetry system for transmitting data on the operation of instruments and scientific equipment to earth.

    The apparatus installed on the satellite is functioning normally. The coordination-computation center is processing the incoming information. [5]

31

TASS ANNOUNCES LAUNCHING OF "KOSMOS-936"

Moscow IZVESTIYA in Russian 5 Aug 77 p 2

[TASS Report: "'Kosmos-936'"]

[Text] The artificial earth satellite "Kosmos-936" was launched in the So-
viet Union on 3 August 1977. It is intended to continue studies of the
effect of spaceflight factors on living organisms and carries experimen-
tal systems with various biological objects as well as radiation physics
apparatus.

During the satellite's flight, experiments to study the effect of
artificial gravitation on biological processes by means of an on-board
centrifuge as well as research aimed at solving the problems of radiation
safety on long space flights will be continued. The satellite carries bio-
logical objects and scientific apparatus from the Soviet Union, Czecho-
slovakia, the United States and France.

The satellite was inserted into an orbit with the following parameters:
-- initial period, 90.7 minutes;
-- apogee, 419 kilometers;
-- perigee, 224 kilometers;
-- orbital inclination, 62.8 degrees.

In addition to the scientific equipment the satellite carries a radio
system for the precise measurement of orbital elements and a radiotelemet-
ry system for transmitting data on the operation of instruments and sci-
entific equipment to earth.

The apparatus installed on the satellite is functioning normally.
The coordination-computation center is processing the incoming informa-
tion.

Specialists from Bulgaria, Hungary, GDR, Poland, Rumania, USSR, Czecho-
slovakia, United States and France will take part in the study and process-
ing of experimental biological material obtained during flight. [5]

COLOR AND BLACK-AND-WHITE PHOTOGRAPHS FROM "SALYUT-5"

Moscow ZEMLYA I VSELENNAYA in Russian No 4, 1977 pp 15-16

[Article by B. V. Volynov, V. D. Bol'shakov, V. M. Zholobov and N. P. Lav-
rova, "The Earth from 'Salyut-5'"]

[Abstract] The "Salyut-5" station was launched on 22 June 1976. The program
of scientific and technical experiments carried out from the manned sta-
tion provided for a space photographic survey for studying the earth's

natural resources. The cosmonauts used films registering features in the visible and infrared spectral regions. The survey apparatus was in the working compartment. It was switched on at computed points in orbit. The optical axis of the survey camera was situated in such a way that each photograph would cover large areas and was also so oriented that it would be possible to determine the spectral characteristics of the earth's atmosphere. The space photographs taken in natural and black-and-white colors gave information concerning a considerable territory of the Soviet Union -- the southern part of the Ukraine, Moldavia, Altay region, Caspian Lowland and waters of the Indian Ocean. The text of this brief article is accompanied by a glossy insert (between pages 16 and 17) showing a color photograph of the Tien Shan and a black-and white photograph of a part of Lake Balkhash and adjacent territories.
[217]

Abstracts of Scientific Articles

CHANGES IN MAXIMUM RADIATION DOSE IN RADIATION BELTS

[Article by O. I. Savun, "Long-Term Changes in the Maximum Radiation Dose in the Earth's Radiation Belts"]

[Abstract] In computing radiation doses on flight trajectories of space vehicles in the earth's radiation belts it is necessary to know the fluxes and spectra of electrons and protons at each point on the trajectory with subsequent integration along the trajectory. Such computations are usually made employing trajectory coefficients which for each orbit make it possible to ascertain by how many times the radiation dose in a particular orbit is less in comparison with the maximum dose which can be received in the radiation belts. The dose in orbit D_{orb} in this case is expressed through D_{max} and the dimensionless coefficients K_1, K_2, K_3. The author uses this approach in ascertaining long-term changes in the maximum radiation dose in the radiation belts. For example, it was found that the decrease in the dose caused by the decay of the belt of high-energy electrons forming after the "Starfish" explosion first transpired relatively rapidly (electron lifetime about a month), but beginning in 1967 the lifetime was about 320 days. Up to 1970 the radiation doses were determined for the most part by electrons of artificial origin and during this time changed by a factor of about 10^3. In the 1970's the nature of the radiation dose became different: it was determined for the most part by inner-belt protons. It was ascertained that the maximum dose intensity in the inner belt in its "natural" state behind a shielding of about 1 $g \cdot cm^{-2}$ is 440± 60 $rad \cdot day^{-1}$. The trajectory coefficients computed for the 1960's are unsuitable for computing D_{orb} in the 1970's because there was a change in the nature of the dose itself, the spatial and energy distribution of the particles determining the dose. The extrapolation of the trajectory coefficients computed for the 1960's to the 1970's gives errors of several times in determining the doses in orbit in comparison with direct experimental data.
[147]

METHOD FOR GAMMA PROBING OF SPACE VEHICLES

[Article by B. S. Gribov, N. N. Repin, V. A. Sakovich and V. M. Sakharov, "Method for the Gamma Probing of Space Vehicles"]

[Abstract] It is often important to know to what degree cosmic radiation, such as the protons of solar flares in the earth's radiation belts, are attenuated by the equipment and construction components of space vehicles. Solution of this problem requires a knowledge of the distribution of solid angles relative to a stipulated point within the vehicle with respect to the thicknesses of equipment material employed. This paper describes the principle of functioning of an apparatus based on gamma probing and a method used in conjunction with it for measuring the distribution of the thicknesses of spacecraft equipment measuring up to 5 m and with a thickness up to 50 g/cm^2. The computations of the passage of protons through matter can be made by this method because for matter with an atomic number $Z < 30$ (the principal construction materials of the spacecraft) the attenuation of gamma radiation with an energy 0.5-1.5 MeV and the energy losses by protons are virtually not dependent on Z and are determined only by the density of the electrons on the radiation path. The determination of the thickness of the equipment is based on a comparison of the intensity of the gamma radiation passing through the equipment and the intensity in its absence. At a fixed point within the vehicle there is an isotropic gamma source and the registry of the unscattered radiation passing through the equipment is by a collimated scintillation detector, moved from the outside of the vehicle using a coordinate system, over a spherical surface with its center at a fixed point. Different aspects of the method are considered, such as the sources of error.
[147]

USE OF TRANSFORMING COMPONENTS IN SPACECRAFT CONSTRUCTION

[Article by I. Belyakov and V. Isachenkov, "Transforming Components"]

[Abstract] A "basic" spacecraft includes its compartment(s), heat insulation and the necessary systems for being put into orbit and return to the earth. There are countless possibilities for modifying or supplementing the basic craft. Extensible, supplementary components can also be used as elements of braking systems for smooth descent of a vehicle onto the surfaces of planets having an atmosphere. One of the important advantages of corrugated parts made of sheet metal is that in addition to compactness and small weight they have a high rigidity in the required directions. However, if for any reason it is necessary to increase their

rigidity still more, various kinds of reinforcements can be used; all
these elements can be put into orbit in a folded state. In those cases
when stamped components are infeasible, they can be fabricated by means of
welding or soldering from shaped elements and individual parts. The open-
ing up of folded metal components from corrugated sheet metal can occur
directly in space. This operation can be performed using electromechanical
systems and also by the use of compressed gas. The latter method is better
since simultaneously with the opening up of the newly formed cavity it is
filled with a gas mixture which can then become an artificial atmosphere
for the presence of man and different living organisms. Only a small pres-
sure is needed for opening up a corrugated metal "shell." For example, for
a "shell" of stainless steel with a diameter of 5,000 mm and with a wall
thickness of 1 mm the greatest pressure for opening is about 2 atm. With
an increase in the cross section of the "shell" the internal pressure de-
creases hyperbolically. The time is not far off when the using of trans-
forming components will make it possible to solve in space many problems
which only recently seemed fantastic.
[119]

POSSIBILITIES OF LIFE ELSEWHERE IN UNIVERSE DEBATED

[Article by Stanislav Lem, with rebuttal by I. S. Shklovskiy, "Are We Alone
in Space?"]

[Abstract] In the June number of this journal there was an article by Cor-
responding Member USSR Academy of Sciences entitled "Alone in the Universe?"
which has drawn a response from the Polish philosopher Stanislav Lem. In
Shklovskiy's article he expressed the opinion that terrestrial civilization
may be a unique phenomenon. Lem feels that Shklovskiy backs his arguments
with substantial facts, but they are negative facts and that these are bas-
ed on what we do not know, not what we do now know. The Polish writer then
presents his case against the unoptimistic views presented by Shklovskiy,
which he feels are defective. In the same issue, Shklovskiy reinforces his
views and responds to many points advanced by Lem, indicating in turn that
the Polish philosopher does not grasp some important considerations in the
realm of science. Shklovskiy states that he is not contending that he has
proved his thesis that we are lonely in space. But he feels that at the
present time, characterized by enormous successes in astronomy, his asser-
tion that for all practical purposes we are alone in space has more scien-
tific basis than the opposite assertion. This is certainly true, in his
opinion, for the local system of galaxies. Perhaps it might be different if
one considers a sphere with a radius of 1,000 light years which contains
approximately ten million stars of all types and classes. From the philo-
sophical point of view, he regards anthropocentrism, at least in the local
system, as sounder and more realistic.
[179]

FEATURE ARTICLE ON COSMONAUTS IN OPEN SPACE

[Article by G. G. Bebenin and Yu. N. Glazkov, "In Open Space"]

[Abstract] It is clear that there is a need for cosmonauts to enter open space. This is true not only for the implementation of scores of research programs from manned ships and orbiting observatories, making rescues from disabled spacecraft, performing repairs on ships, but also in the actual assembly of large orbiting observatories. In going beyond the confines of his ship the cosmonaut must face a whole series of dangers: an intense vacuum, solar radiation and the cold of outer space, to mention only a few, but worst of all -- the possibility of being lost in space. The article gives details about how these difficulties are overcome, followed by a discussion of how the cosmonaut moves, how he orients himself, and the consequences of a loss of orientation. The article particularly emphasizes the cosmonaut as "an autonomous space object" and goes into detail concerning the laws governing his motion in free space and the devices used for his orientation and life support.
[217]

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